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IMPROVEMENTS TO ELECTRICAL WELDING APPARATUSES, IN PARTICULAR TO
APPARATUSES USING A METAL FILLER WIRE
[PERFECTIONNEMENTS AUX APPAREILS DE SOUDAGE ELECTRIQUE, NOTAMMENT AUX
APPAREILS UTILISANT UN FIL DE METAL D'APPORT]

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IMPROVEMENTS TO ELECTRICAL WELDING APPARATUSES, IN PARTICULAR TO 1*
APPARATUSES USING A METAL FILLER WIRE

The invention relates to welding, and in particular to electric welding. Welding methods are known in which a filler wire is supplied in the area of the weld when it is being carried out, with the use of a pay-out reel connected to a torch. The end of the metal filler wire is positioned in the torch across from the weld to be produced. It is fused using an electrical arc formed between the end of the torch and the metallic part on which the weld is carried out. According to the procedures, the electric arc causing this fusion is generated using an electrode placed in the immediate area of the end of the metal filler wire or even the wire itself plays the role of electrode to carry the current feeding the arc.

Such welding machines are largely used to form regular weld beads under operating conditions that are sometimes difficult. They lend themselves to automation of the welding operations. They make it possible to carry out welding with metals that are difficult to use whether because their melting point is high or because there are incompatibilities on the chemical level between the parts to be soldered, or even because they are subject to chemical reactions with /2 the surrounding environment, in particular when they are brought to high temperature. In order to improve their performance, many welding machines are provided with nozzles to blow gas, which may be either inert or active, according to the desired conditions for carrying out

*Numbers in the margin indicate pagination in the foreign text.

the work, in the vicinity of the solder bath.

Due to the complexity of the facilities and the high degree of performance quality that is the goal, it is essential that the supply of the metal filler wire to the torch is ensured in a regular manner that is free of breakdowns. In practice, when using such machines, it can be confirmed that frequently the advance of the metal filler wire is carried out in an intermittent manner or even that the wire is subject to blockages. In addition, in particular in the case where the wire itself plays the role of electrode for formation of the electric arc, it is necessary to transmit very elevated current intensities to the end of this wire. This transmission is carried out by contact. It often happens that, due to the deterioration of the quality of this contact, an inadequate current will be transmitted or that other functional breakdown, such as adhesions, occur that disturb the regular function of the installation.

The invention proposes to eliminate this type of problem in an electric welding installation with metal filler wire.

It provides especially for allowing a more regular function of these installations by ensuring an advance, without breakdown, of the metal filler wire and for limiting machine shutdowns due to breakdowns.

According to another aspect, the invention also provides for improving the function of welding installations equipped with torches equipped with a cooling device. In this regard, the object is to improve the convenience of use of such installations and to diminish

burn-out breakdowns of the torches.

According to a first aspect of the invention, an electric /3
soldering machine is provided of the type comprising a torch that makes it possible to position one end of a metal filler wire across from a part to be machined and to cause its fusion in the area of the part to form a weld and a supply magazine of metal filler wire for the torch is provided. The machine is characterized, in particular, by a means for processing the surface of the wire between the supply magazine and the torch, in particular in view of carrying out cleaning, dust removal, degreasing and/or deoxidizing on it. According to a preferred embodiment, this processing means has an ultrasound cleaning device.

The invention is based on the observations of the requestor, who has recognized that numerous functional breakdowns in electrical welding machines with filler wire, and especially automatic machines, are caused by a poor condition of the wire surface. The metal filler wires used with these types of machine can be very different in function depending on the type of weld to be carried out. However, in numerous cases, the conditions of manufacturing of these wires itself implies that their external surface is greasy, i.e. gummy at the outlet of the manufacturing machine. In addition, these wires which are generally stored on bobbins, tend to unwind during transportation and storage while they are waiting to be used. The dust accumulates still more on their surfaces when the latter is adhesive. These wires can even accumulate soiling in the environment of the welding shop,

which may be dusty. Certain filler materials are also easily oxidized in air.

These imperfections in the surface condition of the metal filler wires are due to accumulations of material that require frequent cleaning to prevent friction and the risk of blocking in the flexible sheath that supplies the torch. In addition, the dust, accumulations /4 of grease or oxides are detrimental to good conduction of the arc supply current due to contact between the supply conductor and the wire.

The tests carried out by the requester have made it possible to confirm that the provision of a means for cleaning the surface of the wire before it goes into the torch and, preferably, in the case of torches mounted at the end of flexible shafts, before they go into the flexible shaft, making it possible to considerably decrease the functional breakdowns connected with the advance of the metal filler wire and its supply of electrical current. In this respect, an ultrasonic cleaning device has proven especially effective to eliminate the different causes of defects on the surface of the wires used. A device such as this also has the advantage of good ease of use. In one embodiment type, the wire passes into a liquid contained in an ultrasonic bath at the output of a pay-out reel. It is easy to start up this installation when a new wire bobbin is provided on the machine.

Ultrasonic cleaning devices are known that use relatively volatile liquids as cleaning agents and carry out a recovery of the

vapors that escape from the vat due to the effect of heating caused by the ultrasonic vibrations, this recuperation being carried out by a condensation of these vapors using a cooling group.

In the case of soldering machines equipped with liquid-cooled torches, it is then provided, according to an especially advantageous embodiment of the invention, to withdraw the calories from the torch refrigerant liquid coming from the latter, also with the cooling group ensuring condensation of the cleaning liquid vapors. /5

A remarkable advantage results, in particular, in the area of convenience of use of soldering machines with torch cooling. In fact, in the known installations, this cooling is usually ensured by a circulation of water in the torch. The hot water coming from the latter passes into a radiator that is cooled by the action of a fan causing a circulation of forced air on the surface of the radiator elements. Other than their lack of efficiency, these embodiments have the inconvenience of being very noisy. The operators of such machines thus have a tendency to limit the use of the cooling devices as much as possible. The risk of burn-out of the torches that sometimes operate at considerable amperages and can increasingly reach very high temperatures (up to 300 to 350°C at the end of the torch) and the risk of functional breakdowns multiplies.

In this respect, and according to a second aspect, the invention also provides for a device for cooling of a welding torch comprising circulation ducts for refrigerant liquid, such as water, in the torch and the means for connecting these ducts to the refrigerant liquid

cooling unit in the area of this torch, this device being characterized in that the cooling unit comprises a group for producing cold in a chamber in which the refrigerant liquid can be circulated.

Other explanations and the descriptions of an embodiment are given below, in a non-limiting manner, with reference to the attached drawing, on which the single figure schematically represents a soldering machine incorporating the principles of the invention.

In the single figure, a welding unit 10 comprises a carriage 12 /6 mounted on casters and connected to a welding torch 18 by a flexible shaft 16. The torch comprises a nozzle 20, of which the diameter is reduced in the direction of its opening 22, for blowing gas into a soldering zone 24 in front of torch 18. Coaxially to the nozzle 20 and on the inside of same, a contact tube 26 is mounted that is pierced by a duct in which a metal filler wire 28 can be advanced. The end 30 of same can be positioned with precision with respect to the weld 24 due to a contact tube 26. The wire 28 is supplied with a strong electrical current by contact between the outer surface and the inner wall of the contact tube duct 26 in such a way as to allow the arcing of an electric arc 32 between the end 30 and the weld zone 34 arranged on a part to be machined. An appropriate potential difference is maintained between the end 30 and this part 34. At its rear end, the contact tube 26 is fastened in the body 36 of the torch 18, the body on which the nozzle 20 also depends. A spiral-shaped duct 38 is arranged in the body 36, in which a refrigerant liquid can circulate in order to

maintain the temperature of the torch 18 within the appropriate limits in spite of the very high currents supplied to the contact tube 26 and the heat released by the arc 32.

The body 36 of torch 18 is fastened at one end of the flexible shaft 16, being connected at the other end with a vertical wall 40 of a chest 56 on the carriage 12. For clarity of the explanations, the end 32 of the flexible shaft 16 has been shown at a slight distance from this wall. The flexible shaft 16 is made up by the meeting, on the inside of an appropriate shaft, of several conduits making it possible to ensure the routing of the metal filler wire 28 to the torch 18, the supply of gas to the nozzle 20 and a circuit of supply and return of the refrigerant liquid circulating in the cooling duct 38.

On the base of the carriage 12, a compressor group 50 is mounted /7 for a refrigeration unit. This comprises a chamber 52 arranged above the group 50 and passed through by classic refrigeration hoses that are not shown, making it possible to withdraw the calories on the inside of this chamber. Above the cooling chamber 52, on feet 54, the chest 56 rests that comprises a supply and cleaning unit for the metal filler wire. The chest 56 is closed with an upper cover 58 that is articulated on hinges 60. On the side of the chest 56, an axle 62 is mounted that forms a support for a movable pay-out reel 64 on which the metal filler wire is wound. This bobbin can easily be changed to make it possible to carry out a different type of weld or, when it is

empty, for its replacement with a full bobbin. At the output of the pay-out reel 64, the metal filler wire 28 passes through a guiding roller 66 and, from there, across a vertical wall 68 of an ultrasound bath 70 by way of a sealed hole 72. In function, the inside of the bath 70 is filled with a liquid 74, a space existing above this bath is filled with vapor from liquid 74. This may consist of a usual industrial solvent, such as Freon, adapted to the ultrasound cleaning installations.

The wire 28 passes to the inside of the liquid 74 by following a trajectory that is slightly inclined from the bottom of the top and again crosses a wall 76 of the bath 70 through a sealed hole 78 in the direction of a driving mechanism 80 comprising several rollers controlled in a classic manner in the welding installations with metal support wire. At the output of the roller guiding device 80, the wire 28 crosses the vertical wall 40 of the carriage 56 through a protective ring 82 before penetrating to the inside of the flexible shaft 16.

The bath 70 is formed on its upper part by a wall 84 in which two pipe connectors 86 and 88 are mounted. The connector 86 is connected by a pipe 90 to a coiled pipe on the inside of the cooling chamber 52. At the outlet of this chamber, it is connected in a contiguous /8 chamber 94, to the aspiration inlet 96 of a pump 98. The supply outlet 100 of the pump 98 is connected by a pipe 102 to the pipe connection 88 at the top of the ultrasound cleaning bath 70.

In the chamber 52, another pipe coil 106 is provided, of which one end is connected to the supply outlet 108 of a pump 110 placed in a compartment 112 close to the chamber 52 below the compartment 94. The other end 116 of the coil pipe 106 is connected at the output of the refrigeration chamber by a pipe 118 to a connector 120 for one of the ends of the supply and return circuits of the refrigerant liquid in the flexible shaft 16. The other end of the circuit is connected by way of a connector 122 to a tank 124 in the compartment 112 by way of a hot water return pipe 126. A plunger tube 128, penetrating into the tank 124 is connected to the suction inlet 130 of the pump 110.

In function, the metal filler wire 28 is fed by the pay-out reel 64 due to the action of the force of attraction produced by the rollers of guiding device 80. It crosses the liquid solvent 74 filling the ultrasound bath 70. In the course of this passage it is cleaned by ultrasound, the bath 70 is placed in ultrasonic vibration by a device, not shown, that is usual in systems of this type. The wire thus cleaned leaves the carriage 12 at the output of bath 70 by way of ring 82 and passes into the duct arranged for this purpose in the flexible shaft. It is advanced by the driving roller 80 gradually as it is used at its end 30 caused by the forming fusion of the weld. The ultrasound cleaning in the bath 70 causes a heating of liquid Freon 74, which evaporates. The vapor is captured by the nozzle 86 and condensed on the inside of the coil pipe 92, the chamber 52 being cooled by the operation of the compressor group 50. The condensate is returned by

the pump 98 to the top of the bath 70.

At the same time, the cooling chamber 52 recovers the calories /9
from the hot water aspirated by the pump 110 and forced into the coil
pipe 106 before being sent, by the connector 120, into the inside of
the flexible shaft 16. The water thus cooled runs through the spiral
cooling duct 38 of the torch 36 and returns by way of connector 122 to
the tank 124.

In this way, functioning of the welding machine with a perfectly
clean metal filler wire is obtained, the ultrasound carrying out a
particularly effective cleaning of the wire surface. Under these
conditions, the guiding duct of the wire on the inside of the flexible
shaft 16 remains clean and the parts in contact with the latter do not
become clogged with soil. In particular, the electrical contact is
made under good conditions between the contact tube 26, supplied from
the current source, which is not shown, by the electrical conductors
also passing through the flexible shaft 116.

At the same time, a very effective cooling of the torch is
ensured and, in the example shown, by making use of one and the same
cooling unit. The torch can thus be used with very high amperage which
can reach or exceed 800 amps. It can continue to function in a
reliable manner for long periods of time without risk of burnout and
while minimizing the breakage and other breakdowns in the regular
advance of the metal filler water.

As regards the cooling of this torch, the invention also presents
the advantage of being adapted very simply to torch cooling systems by

circulation of water that already exist. In comparison to the prior art, it makes it possible to obtain cooling that is even more efficient of the refrigerant liquid and do so in a manner that is almost silent. The welding unit assembly 10 forms a compact unit with high reliability.

The invention is applicable to any type of electrical welding machine with metal filler wire, such as MIG (metal inert gas) machines, MAG (metal active gas) machines or TIG (tungsten inert gas) machines, for example. As regards the aspects of cooling itself, it is also applicable to other types of welding machines with torches, for example to plasma machines. /10

Naturally, the use of the invention can be the object of embodiment variations. It is thus notable that the trajectory of the metal filler wire into the inside of the ultrasound cleaning bath can have configurations other than those that are shown. In the same way, the shape of the ultrasound bath itself can be adapted as a function of the desired trajectory for the wire and the cleaning performance of same that is the goal.

Claims.

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1. Electric welding machine of the type comprising a torch (18) making it possible to position one end (30) of a metal filler wire (28) and to cause its fusion by carrying out a weld (24) and a supply magazine (64) of metal filler wire, characterized by a processing means (70) for the surface of the metal filler wire (28) between the supply magazine (64) and the torch (18), in particular for carrying

out cleaning, dust removal, degreasing and/or deoxidizing.

2. Machine according to Claim 1, characterized in that the said processing means comprise an ultrasound cleaning device (70).

3. Machine according to Claim 2, characterized in that the ultrasound cleaning device comprises an ultrasound bath (70) filled with a liquid (74) in which the metal filler wire to be cleaned circulates and cooling means (50, 52, 92) for condensation of the vapor escaping from the ultrasound bath.

4. Machine according to Claim 3, characterized by ducts to circulate a refrigerant liquid in the torch (18), these ducts (118, 126) being connected to the said cooling means (50, 52) for the cleaning liquid vapor to cool the refrigerant liquid of the torch.

5. Machine according to Claim 4, comprising a soldering unit (12) on which the supply magazine (64) is mounted, characterized in that the ultrasound cleaning device (70) is mounted at the output of the supply magazine with its cooling means (50, 52) connected to this unit, this unit (12) being connected to the torch by a flexible shaft (16) comprising guiding means for the metal filler wire (28) at the outlet of the ultrasound cleaning device and two pipes for supply and return circulation of the refrigerant liquid of the torch, these pipes extending to the inside of the unit by a cooling coil pipe (106) into a chamber (52) of the said cooling means. /12

6. Device for cooling a welding torch comprising the circulating ducts for refrigerant liquid in the torch and means for connecting these ducts to a cooling unit with refrigerant liquid coming from the

torch before returning to it, characterized in that this cooling unit comprises a cold production group (50) comprising a cooling chamber (52) in which an exchanger duct (106) and the means (110) to circulate the refrigerant liquid in this duct are installed.

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